

Distributed Generation Systems

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Distributed Generation Systems					
Fuel Cells	59,107	68,644	23,000	-45,644	-66.5%
Novel Generation	2,927	2,469	0	-2,469	-100.0%
Total, Distributed Generation Systems	62,034	71,113	23,000	-48,113	-67.7%

Description

The objectives of the Distributed Generation Systems Fuel Cell activity are to provide the necessary technology base development of fuel cell systems for electric utility, industrial, and commercial/residential markets; and to provide technologies that improve U.S. international competitiveness in this new manufacturing industry.

Benefits

Fuel cell modules in IGCC and FutureGen systems have the potential to double the efficiency of coal-based systems and achieve near-zero emissions. Fuel cells can concentrate CO₂ which lends itself to removal by separation or other capture means. Fuel cells provide a bridge to the hydrogen economy by using coal derived hydrogen to produce power efficiently and by offering the potential to produce hydrogen, as well as electricity, from coal.

Background

Fuel cells and other innovative power systems are being developed for distributed generation applications that can create public benefits by enhancing the overall efficiency, security and reliability of the Nation's energy supply. The Fuel Cells Program supports the President's climate change goals by increasing the efficiency of electricity production, creating the potential for over 50% reduction in CO₂. It supports the Clear Skies Initiative with near zero NO_x, SO_x, and mercury emissions, and it supports energy security goals distributed generation alternatives to grid-based power and through multi-fuel capability (less dependence on one fuel). High-temperature fuel cells can operate on hydrogen and hydrogen carriers such as methane and syngas. Low-cost, ultra-high efficiency, fuel flexible, integrated fuel cell/turbine hybrids systems for snynfuel and hydrogen-based plants will provide essential power modules for FutureGen projects and concepts in the 2010 to 2015 time frame. Hence, the Distributed Generation Program is a bridge to the hydrogen economy of the future envisioned in the FreedomCAR and Hydrogen Fuel Initiatives.

Distributed generation complements electricity supply from central generation systems, by providing another source of energy through smaller-scale production of electric power in stationary plants at or

near the end user. Fuel cells as small modular resources may be used on a stand-alone basis, or integrated with other generators, and even connected to a central system grid. These systems may be owned and/or operated by utilities, utility customers, and third parties. Fuel cell systems are capable of reducing criteria pollutants well below current New Source Performance Standard levels, reducing non-criteria pollutants such as CO₂ and acid rain precursors, and reducing thermal emissions to the environment. Fuel Cells systems provide important carbon management options because of their inherently low emissions and ultra-high efficiency, and significant water conservation options because they can be operated in areas where water resources are scarce.

Fuel cell applications in distributed generation systems offer potential opportunities for cost-effectively meeting peak demand without the need for costly investments in transmission and distribution. They can be used to provide clean power to remote end users; and can provide new business opportunities in both utility and non-utility owners.

The Fuel Cells Program is leveraging technical innovation to develop advanced power systems for distributed generation that will improve power quality, boost system reliability, reduce energy costs, and help delay/defer capital investments. The program goal is to develop low-cost, high efficiency, fuel flexible, modular power systems with lower cost, higher quality electricity, and significantly lower carbon dioxide emissions than current plants, as well as near-zero levels of pollutants.

The current strategy is to develop clean high efficiency fossil fueled powerplants: Immediate near-term (2005-2006) - develop and conduct initial proof-of-concept tests of the Solid State Energy Conversion Alliance (SECA) low-cost, 3-10 kilowatt solid-state fuel cell modules for distributed and auxiliary power unit applications; Mid-term (2007-2010) - develop and test SECA fuel cell prototype modules capable of manufacture of \$400 per kilowatt (a ten-fold reduction from today's cost), and develop combined cycle \$400 per kilowatt gas-based fuel cell/turbine hybrids under Vision 21 Hybrids that will enable the design of synfuel and hydrogen-fueled hybrid powerplants; Long-term (2010-2015) - develop and demonstrate the critical high risk technology advancements which will permit U.S. industry to establish commercial availability of advanced, low-cost, ultra-high efficiency, fuel flexible, integrated fuel cell/turbine hybrids systems for synfuel and hydrogen-based plants. Fuel cell systems have specifically identified goals which coincide with coal-based and other fuel-flexible Vision 21 power modules and concepts in the 2010 to 2015 time frame.

Currently, the Advanced Research subactivity within the Fuel Cell program supports the program objectives by conducting research to identify new, highly innovative electrochemical technology concepts and by solving fundamental crosscutting high-temperature electrochemical issues through the High Temperature Electrochemistry Centers (HiTec) at PNNL and Montana State University.

Currently, the Fuel Cell/Turbine Hybrids subactivity under Vision 21 provides a alternative options for deploying fuel cell systems in a variety of applications. Integration into a single system lowers system costs and increases system efficiency. Hybrid power modules are expected to be a key enabling technology for long-term FutureGen and Vision 21 systems. Hybrid power modules are important element of the Department's hydrogen initiative and strategies for carbon management.

The Innovative Concepts subactivity includes the Solid-State Electricity Conversion Alliance (SECA), the Department's major initiative for stationary fuel cells development. The objective of the SECA is to drastically reduce fuel cells costs to make them a broadly applicable and more widespread commodity in the competitive, mature distributed generation and auxiliary power markets. The SECA program incorporates an integrated strategy to address the technical barriers of solid-state fuel cell systems within the cost constraint of \$400 per kilowatt for a complete system. The benefits of SECA are projected by NEMS to include \$15 billion saving through Clear Skies and Climate Change emissions reductions by 2025 from 50 GW of SECA fuel cell capacity. Additional management benefits can be expected to accrue with the introduction of SECA hybrid systems. Work under SECA core program includes, gas processing (reforming and cleanup), power electronics, controls and diagnostics, heat recovery, modeling and simulation, and material and manufacturing/fabrication research at universities and national laboratories. SECA industry teams are engaged in the development of common modules for diverse applications in multiple and mobile market applications. SECA includes exploration of designs that combine functions to reduce size, weight, and costs.

The Fossil Energy R&D program is committed to searching for promising new ideas for low-cost, low-pollutant power generation. In recent years, Fossil Energy R&D has funded research on the Ramgen engine, an innovative power systems technology under the Distributed Generation Systems Novel Generation Concepts activity. The Ramgen system is capable of utilizing a variety of fuel gases including waste gases, and components of Ramgen show potential for adaption to other power systems.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Fuel Cells	59,107	68,644	23,000

The focus of the Fuel Cells program is to reduce cost by an order of magnitude enabling the widespread deployment of clean reliable fuel cells and fuel cell hybrids for distributed generation, FutureGen, and Vision 21 applications through low-cost, ultra-clean, and ultra-high efficiencies.

Advanced Research.....	3,389	9,876	0
• Advanced Research	3,354	9,778	0

In FY 2005, no additional work is planned in this category. DOE considers these technologies at a point of development where industry can pursue their commercial development without further Federal funding.

In FY 2004, fund research to develop a fundamental understanding of processes that limit the performance of high temperature electrochemical systems. Such systems have applications in fossil energy conversion, energy storage, and electrolysis. Parallel experimental and modeling activities, research conducted by HiTEC will eventually lead to new concepts and technologies in fossil fuel utilization. *Participants to be determined.*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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FY 2003 funding continued generic research to capitalize on the intrinsic high efficiency and environmentally benign characteristics of advanced electrochemical technology. Research will be conducted to identify new highly innovative electrochemical technology concepts and to solve fundamental crosscutting issues. *Participants included: ANL, PNNL.*

- **Program Support**..... **35** **98** **0**

Fund technical and program management support.

Fuel Cell Systems **9,675** **10,865** **0**

- **Fuel Cell Systems**..... **9,576** **10,757** **0**

In FY 2005, no additional work is planned in this category. DOE considers these technologies at a point of development where industry can pursue their commercial development without further Federal funding.

In FY 2004, with the conclusion of molten carbonate fuel cells stack development in FY 2003, this subactivity will support advanced fuel cell systems development and testing in a variety of crosscutting areas in FY 2004.

FY 2003 funding continued cost-shared cost reduction and performance improvement on one full molten carbonate system for market entry by the private sector; continue supportive distributed generation infrastructure, economic and market study assessments and system assessments and evaluations. *Participants included: FCE.*

- **Program Support**..... **99** **108** **0**

Fund technical and program management support.

Vision 21 Hybrids..... **13,062** **12,840** **0**

- **Vision 21 Hybrids** **12,928** **12,712** **0**

In FY 2005, no additional work is planned in this category.

In FY 2004, conduct a redirected Vision 21 enabling cost reduction and performance enhancement program with low-cost Vision 21 fuel cell/turbine hybrid technologies; explore Vision 21 zero-emissions system concepts; conduct system studies and explore fuel flexibility and integration issues as permitted. *Participants include: NETL, GE, FCE, Siemens.*

FY 2003 funding continued a Vision 21 enabling cost reduction and performance enhancement program with Vision 21 fuel cell/turbine hybrid technologies, such as the tubular SOFC hybrid; conduct system studies and explore fuel flexibility and integration issues as permitted. *Participants included: SWPC, NETL, GE, FCE.*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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- **Program Support**..... 134 128 0

Fund technical and program management support.

Innovative Systems Concepts..... 32,981 35,063 23,000

- **Innovative Systems Concepts** 32,643 34,712 22,770

In FY 2005, begin prototype validation of Phase I technical requirements for low-cost SECA fuel cell systems; enhance individual components and systems performance; conduct SECA core technology R&D to resolve crosscutting technical issues; develop innovative reformers, sensors, and controls; initiate designs of coal-derived gas-based SECA systems as permitted. *Participants include: GE, Siemens Westinghouse, Delphi, FCE/MRI, Acumentrics, Cummins-SOFC, PNNL, ANL, NETL, and other core technology participants.*

In FY 2004, **SECA** - Develop four concept designs for prototype mid- to high-temperature low-cost solid state fuel cell systems; develop SECA core technology for materials to reduce manufacturing costs, enhance performance, and develop innovative sensors and converters; initiate designs of hybrid coal-based SECA systems. *Participants include: GE/Honeywell, Siemens Westinghouse, FCE/Versa Power, Acumentrics, Delphi, Cummins-SOFC, ANL, PNNL, NETL, and other core technology participants.*

FY 2003 funding continued the mid- to high-temperature low-cost SECA solid state fuel cell program; fund multiple SECA industrial teams and a core technology program; conduct coal-based SECA-hybrid integration studies as permitted. *Participants included: McDermott, ADL, NL, NETL.*

- **Program Support**..... 338 351 230

Fund technical and program management support.

Novel Generation 2,927 2,469 0

In FY 2005, no additional work is planned in this category. DOE considers these technologies at a point of development where industry can pursue their commercial development without further Federal funding.

- **Supporting Technologies** 2,897 2,444 0

In FY 2005, no additional work is planned in this category.

In FY 2004, continue to openly solicit new fossil-fuel based power generation technology that shows promise of improving efficiencies and/or lower emissions through the novel concepts program. *Participants to be determined.*

FY 2003 funding was used to issue a solicitation for novel generation systems.

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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• Program Support	30	25	0
Fund technical and program management support.			
Total, Distributed Generation Systems	62,034	71,113	23,000

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Fuel Cells

Advanced Research

• In FY 2005, no additional work is planned in this category	-9,778
• Program Support	-98
Total, Advanced Research	-9,876

Fuel Cell Systems

• In FY 2005, no additional work is planned in this category	-10,757
• Program Support	-108
Total, Fuel Cell Systems	-10,865

Vision 21 Hybrids

• In FY 2005, no additional work is planned in this category	-12,712
• Program Support	-128
Total, Vision 21 Hybrids	-12,840

Innovative Systems Concepts

• Decrease in Innovative Systems Concepts due to FutureGen funding priorities	-12,012
• Program Support	-121
Total, Innovative Systems Concepts	-12,063

Novel Generation

• In FY 2005, no additional work is planned in this category	-2,444
• Program Support	-25
Total, Novel Generation	-2,469
Total Funding Change, Distributed Generation Systems	-48,113